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SAFETY REQUIREMENTS FOR THE STRUCTURES IN AN EARTHQUAKE PRONE ZONE

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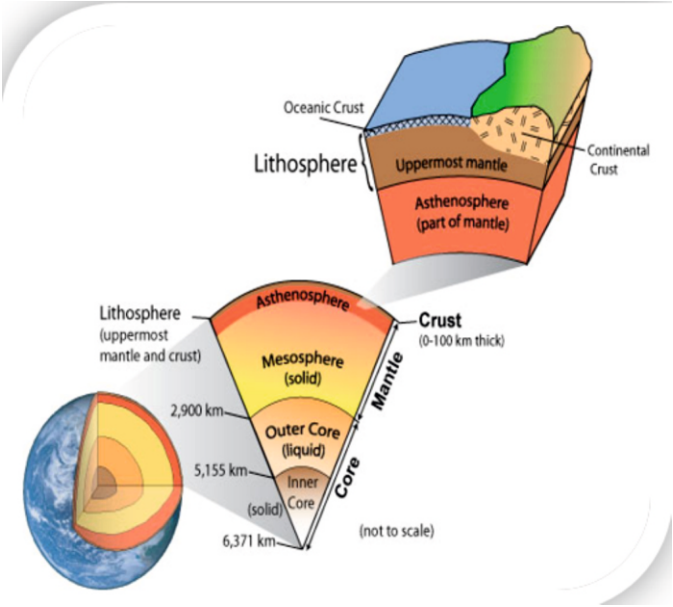
ABSTRACT

Recently, due to the changes in the environment because of pollution created by developed countries with advanced techniques – Since, it is necessary that to control the pollution. Population increases with great or highest speed. And because of population – pollution increases. And therefore Pollution takes a critical look. This critical look classified into hazardous, dangerous with minimum rainfall in some places, maximum rainfall without rainy season, maximum snowfall, tsunami, earthquakes and higher increment in the temperature – and due to this melting of ice takes place. These are the most critical faces of the environment. And one of them is nothing but the earthquakes. Now a day's earthquake is major drawback in all over the world. This issue is very serious as per the effects on the living organisms such as birds, animals and also on the humans. Similarly on the structures which are present in the world. Due to this, it is necessary that safety is most and the most important not for the structures but also the life of all living organisms present on the earth surface. Earthquake is nothing but the horizontal and/or vertical movement of the earth surface. Some theories are given related to the earthquake. Seismic waves are developed. In this paper the whole safety measures and different methods are utilised. Various techniques with variation in materials are used. In this paper also, safety requirements for the structures in an earthquake prone zone are given.

KEYWORDS: Earthquake, Environment, Pollution, Population, Disasters.

1.Introduction:

An earthquake may be defined as a wave like motion generated by forces in constant turmoil under the surface layer of the earth, travelling through the earth's crust. It may also be defined as the vibration, sometimes violent of the earth's surface as a result of a release of energy in the earth's crust. But the simple definition of an earthquake is horizontal and vertical movement of the earth surface. An earthquake is a sudden tremor or movement of the earth's crust, which originates naturally at or below the surface. The word natural is important here, since it excludes shock waves caused by nuclear tests man-made explosions, etc. About 90% of all earthquakes result from tectonic events, primarily movements on the faults. The remaining is related to volcanism, collapse of subterranean cavities or man-made effects. At the time of earthquakes, energy released. This release of energy can be caused by sudden dislocations of segments of the crust, volcanic eruptions, or even explosions created by humans. Dislocations of crust segments, however, lead to the most destructive quakes. In the process of dislocation, vibrations called seismic waves are generated. These waves travel outward from the source of the earthquake at varying speeds, causing the earth to quiver or ring like a bell or tuning fork. During an earthquake, enormous amounts of energy are released. The size and severity of an earthquake is estimated by two important parameters such as magnitude and intensity. The magnitude is a measure of the amount of energy released, while the intensity is the apparent effect experienced at a specific location. Tectonic earthquakes are triggered when the accumulated strain exceeds the shearing strength of the rocks. Elastic rebound theory gives the physics behind earthquake genesis. For study of an earthquake firstly know all about the earth. The earth is composed of a sequence of shells or layers called geospheres, the heaviest of which forms the core. The various geospheres that constitute the earth are Barysphere, Asthenosphere and lithosphere. Barysphere also called as core and is the central part. Asthenosphere also called as mantle. It is after the core or barysphere. And last one is Lithosphere which is also known as crust. It is the outer most part. Seismic waves are classified into two types namely first body waves and second is surface waves. After that body waves are divided into two types i.e., Primary or P-waves and Secondary or S-waves. Also surface waves are divided into two types i.e., Love or L-waves and Rayleigh waves. Body waves travel through the interior of elastic media and surface waves are bound to free surfaces. For earthquake resistant design of structure different IS Codes are used such as IS:1893:2002, IS:1893:2005. In RCC Structures IS:456:2000 is used with all specifications related construction of all types of buildings and frames also.



2.Methodology:

Everyone knows that earthquakes are very hazardous, critical. Earthquake is one of the biggest disasters in all over the world. So, at the time of construction of all types of structure, safety measures are required. Precautions should be taken in earthquake prone zone. Therefore, for the safety point of view make the structure earthquake resistant. And for that follow the procedure given as IS:1893:2002, IS:1893:2005, IS:13935:1993, IS:456:2000, IS:800:2007, IS:13920:1993, IS:875:1987(Part 1,Part 2,Part 3). Design criteria is given in the IS Codes. Whole analysis and design is done by standard specifications given in the IS Codes. Different methods of analysis & design are given in the IS Codes. As per IS:1893:2002(Part 1) methods such as Static method and Dynamic method. Both methods include many more methods such as seismic coefficient method, response spectrum method, time history method, push over analysis method etc. IS:1893:2002(Part 1) is used for – Criteria for earthquake resistant design of structures: General Provisions And Buildings. In this IS Code – static and dynamic methods are given as said earlier. All data required in static and dynamic method like design parameters, different load combinations, different formulae's as per requirements, mode shapes and many more. IS:13935:1993 is used for – Repair And Seismic Strengthening of Buildings- Guidelines. After the earthquakes, maximum repairing work is required. Due to the earthquake, seismic strengthening is required.

Repair: To make the existing structure safer for future earthquake. Repair means refilling of the materials. Reconstruction or renewal of any part of a damaged or deteriorated building to provide the same level of strength. Repairs may be non-structural or architectural. Repair includes:

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- Patching up of defects such as crakes and fall of plaster;
- Repairing doors windows, replacement of glass panes;
- Checking and repairing electric conduits/wirings;
- Checking and repairing gas pipes, water pipes and plumbing services;
- Re-building non structural walls, smoke chimneys and parapet walls etc.

Following are the repair materials used in repairing:
- Grout
- Epoxy Resin
- Epoxy Mortar
- Shotcrete
- Quick Setting Cement Mortar
- Microconcrete
- Fibre Reinforced Concrete
- Fibre Reinforced Polymer
- Ferro cement etc.

Following are different techniques used in repairs:
- Repointing
- Grouting
- Guniting
- Shotcreting etc.

By using these materials and techniques reached the original maximum strength.

Strengthening: The process of strengthening involves improving the original strength of the structure. It is carried out when the evaluation of the building indicates that the strength available before the damage was insufficient and restoration alone will not be adequate for resistance of future earthquakes.

Retrofitting: Increasing the seismic resistance of a damaged building is called retrofitting. To upgrade the earthquake resistance up to the level of the present day codes by appropriate techniques. Techniques are given in the IS Code. Retrofitting techniques are classified into two types namely first Global technique and Local technique.

Now Global Techniques are:
- Adding shear wall
- Adding infill wall
- Adding Bracing
- Adding Wing Wall/Buttresses
- Wall Thickening
- Mass Reduction
- Supplemental Damping And Base Isolation

Local Techniques:
- Jacketing Of Beams
- Jacketing Of Columns
- Jacketing Of Beam Column Joints
- Strengthening Of Individual Footings

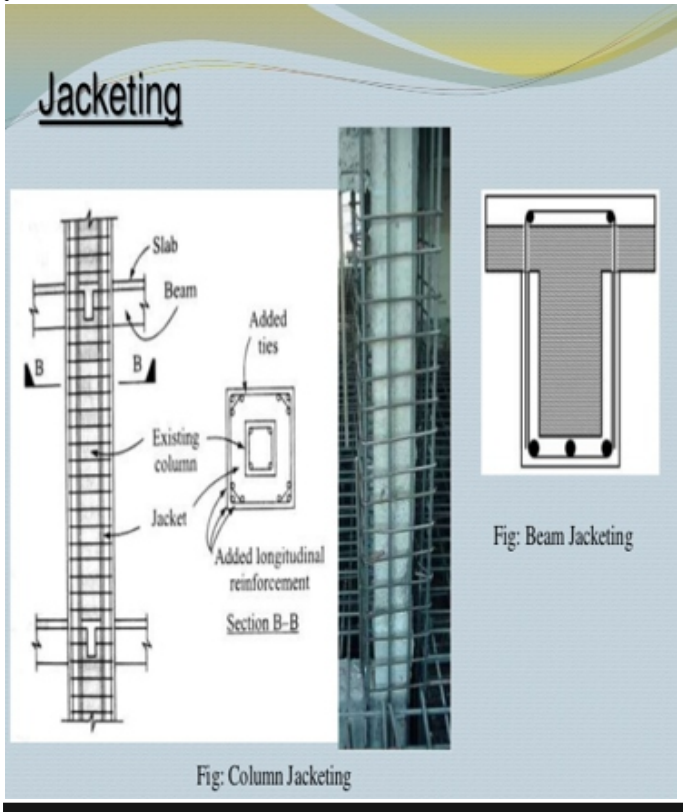

Fig: Column Jacketing

Fig: Beam Jacketing

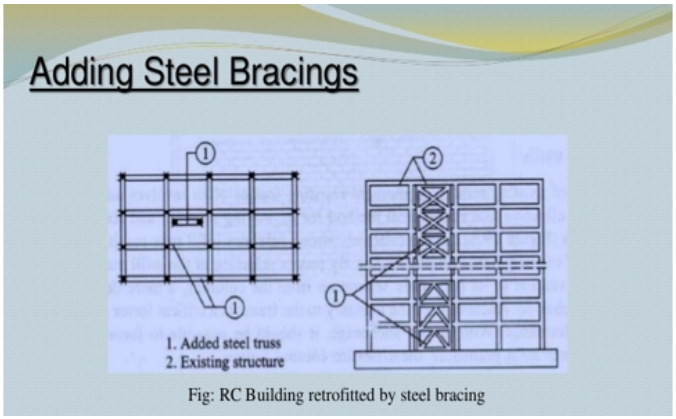

Fig: RC Building retrofitted by steel bracing

3.Concepts & Study:
Following points should be kept in view related to design of earthquake resistant structure.

1) Use standard and modified methods of analysis and design.
2) Adopt Design criteria for construction as per IS Code specified for different structures.
3) Strong column –weak beam concept.
4) Design Philosophy
5) Higher grade of steel and concrete
6) Conceptual design
7) Use materials which are given in IS Code.
8) Check out the topography of the respective area.
9) Geology of the area
10) Environmental conditions
11) Study past earthquakes
12) Provision of steel bracings
13) Provision of different repair materials and techniques
14) Criteria for strengthening
15) Retrofitting
16) Rehabilitation
17) Adopt structure as per seismic severity
18) Zonal Study
19) Use foundation depending on SBC of soil and total weight on it
20) Provision of shear wall depending on severity of lateral force.

4. Conclusion:
From this detailed study, the final conclusions made are:
- Reduces the damages of life at greater extent
- Minimizes the effects of this big Disaster
- Due to the use of repair materials – try to get the original strength
- Repair, Retrofitting and strengthening are the best techniques or technology for protection of different structures
- By using all facts and concepts – analysis and design more easy
- Reduces the damages in all type of structures
- Gaining more knowledge from past study
- Know in detailed about design philosophy
- Finally safety is more important related to all
- To reducing the pollution

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